The name “AdvanCer” conveys a sense of foresight, progress and benefit. Ceramics manufacturers and users find in it their “Advanced Ceramics” – materials holding great promise for the future. AdvanCer presents innovative applications for high-performance ceramics: systems solutions with “Ceramics inside” for today and tomorrow.

After establishing its main location in Dresden, »AdvanCer« now has branches at all other participating Institute locations. In this issue, we will take a look at the Berlin location. The celebration took place on September 27, 2004 to commemorate the 100th anniversary of the opening of the Institute for Machine Tools and Factory Management (IWF) at the Technical University of Berlin, located together with the Fraunhofer Institute for Production Systems and Design Technology (IPK) at the Production Technology Center (PTZ) in Berlin. Over the following two days, the 11th Colloquium on Production Technology was the platform for presentations from politics, industry and science treating main themes in the development planning of important branches of industry and addressing current problems in production economics.

»AdvanCer« at Fraunhofer IPK in Berlin.

»AdvanCer« took this opportunity to present its activities to a wide audience for the first time ever in the test stand area for finishing of ceramic components at PTZ.

Berlin and the »AdvanCer« demo center invite you to visit anytime!

View of the Spreebogen, where the Spree river curves, and the back of the Production Technology Center, with the round test area in the center.

Crowd of visitors at the Production Technology Center in Berlin during 100th anniversary celebration.
Components made of technical ceramics cannot be designed in the same way as metals are due to the properties of the materials used. Limited possibilities for production of large parts and the expense of hard machining with diamond tools necessitate special procedures for the overall design process and suitably developed criteria enabling reliable sizing of ceramic components. The following paragraphs focus on one aspect of design for ceramics, namely, component dimensioning. Particular emphasis is placed on components under cyclic loading conditions such as those found in real-life applications.

Strength values and loading conditions

Determination of strength values should be done using conditions that are as close to real ones as possible. However, relatively small test specimens (e.g. bending specimens) are usually used to obtain strength values. The probability that strength-limiting pores or inclusions are present is lower for small test specimens than for large components. Therefore, strength properties of test specimens can only be applied to larger components if fracture mechanics methods taking into account the material volumes under stress are used. Fracture can be preceded by a crack growth phase, which can be initiated by static or cyclic stresses, e.g. concentrated at pores, grains or cracks. Because failure generally occurs in tensile loading, cyclic loading with tensile mean stresses translates into a decrease in dynamic strength. Permissible stresses specified in material datasheets are only valid for predefined material conditions and test specimen dimensions. Deviations in dimensions of stressed segments and the possibility of crack growth at low stresses or cyclic fatigue effects must be taken into consideration using conversions based on fracture mechanics relationships. This reinforces the importance of measures for identification of defects and determination of their sizes, geometries and positions.

Dimensioning

What should be the procedure for dimensioning? For reliable sizing of a component given a specific lifetime target, the maximum allowable stresses must be compared with the stresses occurring in real-life applications. Whether local component stresses are determined using FE-based analysis or using conventional calculation methods depends on the complexity of the component and the extent of overlap of stress types (thermal, tribological, corrosive, static and/or cyclic mechanical), a phenomenon typically occurring when technical ceramics are employed. Depending on the application in question, the probability of failure may also be a factor that needs to be considered. Model experiments reproducing the loading conditions sufficiently accurately enable characteristic values, including Wohler (S-N) curves and crack growth parameters valid for long-term applications, to be determined.

Verification of results

Even if investigations and calculations suggest that the local stresses on a component are not critical, verification under service conditions must often be performed after prototype production, if the application in question requires it.
News
»AdvanCer« at China Materials 2004

With the Fraunhofer Representative Office in Beijing acting as a liaison, »AdvanCer« and Fraunhofer ISC presented their fields of expertise at China Materials, held on September 21 to 24 in Beijing. Keen interest was shown in the measurement capabilities of TOMMI – one of the »AdvanCer« exhibits – demonstrated at a colloquium held during the event.

Change of office at Fraunhofer IKTS

Leadership of the Fraunhofer Institute for Ceramic Technologies and Sintered Materials was handed over by Prof. Dr. Waldemar Hermel to Prof. Dr. Alexander Michaelis during a colloquium held on Friday, October 22, 2004. Prominent speakers, including the president of the Fraunhofer-Gesellschaft, Prof. Dr. Hans-Jörg Bullinger, the CEO of Bayer Innovation GmbH, Prof. Dr. F. Heiker, and the vice-president of the Memory Development Center at Infineon AG, Dr. J. Rüstig, presented their ideas and results on the topic of »innovation through cooperation.« The event was moderated by the spokesman of the Fraunhofer-Gesellschaft’s Alliance for Materials and Components, Prof. Dr. G. Müller, who portrayed IKTS in the context of the colloquium. During the subsequent change of office, the secretary of state of the Saxony State Ministry for Science and the Fine Arts (SMWK), Dr. Frank Schmidt, the president of the Fraunhofer-Gesellschaft, Prof. Dr. Hans-Jörg Bullinger, and the rector for university planning at TU Dresden, Prof. Hans-Georg Marquardt, praised the successful work of Prof. Dr. Waldemar Hermel and welcomed the new institute director, Prof. Dr. Alexander Michaelis to office.

Events

Two interesting seminars are being offered by MSTI® - Materials and Surface Training Institute. The seminar entitled »Basics of Ceramics«, organized jointly with »AdvanCer«, will be held at three different locations. It can be combined with the seminar entitled »Function-Based, Stable Design Using Ceramics«. Individual dates and locations for »Basics of Ceramics« are as follows:

February 21 and 22 in Passau
May 30 and 31 in Köln
September 12 and 13 in Freiburg

Check www.msti-aktuell.de for further information on seminar topics.

The Fraunhofer »AdvanCer« demo center will be organizing its own training program for technicians and engineers starting in 2005. The three training blocks on offer are meant to be taken consecutively, but they can also be taken individually. Dates and locations are as follows:

Block 1
Introduction to Ceramics: Manufacture, Properties, Applications
March 15, 2005 in Dresden

Block 2
Machining of Ceramics
June 21, 2005 in Aachen

Block 3
Systems Integration, Quality Assurance, Materials Testing
September 27, 2005 in Freiburg

Interested parties and prospective participants should contact the »AdvanCer« business office in Dresden.

If you are interested in any of the topics related to our service offerings – tell us. »AdvanCer« will put together a customized program for you, including relevant topics from our range of pilot plant and laboratory capabilities!
ETEC Gesellschaft für Technische Keramik mbH, innovator of ceramic products for ballistics and wear protection, has opened up new possibilities for ski jumping by providing the matting for the world's highest matted ski jump in Bischofshofen, Austria.

Current double world champion, Adam Malysz from Poland, tested out «the new feeling» and proclaimed it to be the best thing he'd ever had under his skis. The hill record of 142 m was already reached in a test jump.

Ceramic particles forming bumps in the in-run are moistened with water to provide nearly the same level of sliding properties as snow does. The out-run is covered with plastic mats. This system has already been certified for use at the Olympic Winter Games in Turin in 2006. According to ETEC’s sales manager and coinventor, Rainer Steven, «the secret lies in the outstanding properties of high-performance ceramics, such as an enormous sliding capacity and a long lifetime, as well as the special bump geometry we use.» The contact area between skis and the ski jump is minimized, thus enabling long jumps to be achieved. The ceramic particles are embedded in a newly developed rubber mass, which is then vulcanized and fastened to track modules made of PVC. This ensures an extremely quiet run.

The entire in-run can be kept free of snow and ice through use of an integrated electrical heating system. In summer, the built-in sprinkler system ensures that conditions on the jump remain optimal.

**Carbon-ceramic brake disks for high-performance vehicles**

Improving safety and lifetime and lowering mass are key goals in vehicle development. To this end, development engineers are constantly on the lookout for innovative components made of new lightweight materials. The specialists at SGL Brakes GmbH made considerable progress in brake technology by introducing carbon-ceramic brake disks, which the company, now the world's leading supplier of these components, developed in Meißen, near Augsburg, Germany. In July 2002 industrial production facilities with a capacity of 40,000 brake disks a year opened. Since this time carbon-ceramic brake disks have been supplied to a German sports car manufacturer as standard features and other car manufacturers as prototypes.

Compared with conventional ones, carbon-ceramic brake disks have a much better responsiveness in all weather conditions, thus significantly lowering the braking distance. In addition, they provide constant braking action — even for rapid repeated braking. With a mass that is up to 50% lower than that of conventional brakes, these brake disks also offer increased driving comfort, as they reduce the unsprung masses on the wheels. Their lower wear rates also result in better mileage.